DOCUMENT RESUME

ED 289 164 CS 210 840

AUTHOR	Matthiessen, Christian
TITLE	Notes on the Organization of the Environment of a Text Generation Grammar. ISI Reprint Series.
INSTITUTION	University of Southern California, Marina del Rey. Information Sciences Inst.
SPONS AGENCY	Air Force Office of Scientific Research, Washington, D.C.
REPORT NO	ISI/RS-87-177
PUB DATE	Apr 87
CONTRACT	F49620-84-C-0100
NOTE	42p.; Reprinted from G. Kempen, Ed. Natural Language Generation: Recent Advances in Artificial Intelligence, Psychology, and Linguistics. Boston/Dordrecht: Kluwer Academic Publishers, 1987. Paper presented at the International Workshop on Text Generation (3rd, Nijmegen, The Netherlands, August 19-23, 1986).
PUB TYPE	Viewpoints (120) -- Information Analyses (070) -- Speeches/Conference Papers (150)
EDRS PRICE	MF01/PC02 Plus Postage.
DESCRIPTORS	*Artificial Intelligence; Cognitive Processes; Cognitive Psychology; Computer Uses in Education; Discourse Analysis; *English; *Grammar; Language Patterns; *Language Processing; Language Research; Linguistics; *Linguistic Theory; Models; Psycholinguistics; Semantics; Syntax; Vocabulary
IDENTIFIERS	*Functional Linguistics; *Natural Language Processing

ABSTRACT

Taking the lexicogrammatical resources (i.e. the vocabulary and syntax) of English as a starting point, this report explores the demands those resources put on the design of the part of a text generation system that supports the process of lexicogrammatical expression. The first section of the report notes that a reason for using the lexicogrammar to infer the organization of other parts of the system is that more is known about lexicogrammar than about the organization of other parts, because of accounts by functional linguists. The second section discusses the interface between grammar and environment (the knowledge base and discourse model) and focuses on its organization. Functional decomposition of grammar and environment is investigated in the third section, which includes a discussion of metafunctions in the grammar (experiential, logical, interpersonal, and textual). The fourth section deals with the knowledge base of a text generator, and includes discussion of how semantic types and grammatical classes are related and how phenomena are classified. Additional topics in this section are: (1) the (logical) sequential organization of supercomplex phenomena; (2) the (experiential) configurational kind of organization of configurations; (3) correlations between taxonomies in the knowledge base; and (4) metaphor. The discourse model and its components (theme, conjunction, and determination) is examined in the fifth section, while the sixth section presents specific examples and summary. Notes and references conclude the report. (SKC)

ED289164

U.S. DEPARTMENT OF EDUCATION
Office of Educational Research and Improvement
EDUCATIONAL RESOURCES INFORMATION CENTER (ERIC)

This document has been reproduced as received from the person or organization originating it.

☐ Minor changes have been made to improve reproduction quality.

• Points of view or opinions stated in this document do not necessarily represent official OERI position or policy.

ISI Reprint Series
ISI/RS-87-177
April 1987

University of Southern California

Christian Matthiessen

Notes on the Organization of the Environment of a Text Generation Grammar

Reprinted from
Natural Language Generation: Recent Advances in Artificial Intelligence, Psychology, and Linguistics.

CS 210 840

INFORMATION SCIENCES INSTITUTE

213/822-1511
4676 Admiralty Way/Marina del Rey/California 90292-6695

BEST COPY AVAILABLE

Unclassified

SECURITY CLASSIFICATION OF THIS PAGE

REPORT DOCUMENTATION PAGE

1a. REPORT SECURITY CLASSIFICATION Unclassified	1b. RESTRICTIVE MARKINGS
2a. SECURITY CLASSIFICATION AUTHORITY	3. DISTRIBUTION / AVAILABILITY OF REPORT This document is approved for public release; distribution is unlimited.
2b. DECLASSIFICATION / DOWNGRADING SCHEDULE	
4. PERFORMING ORGANIZATION REPORT NUMBER(S) ISI/RS-87-177	5. MONITORING ORGANIZATION REPORT NUMBER(S) ---
6a. NAME OF PERFORMING ORGANIZATION USC/Information Sciences Institute 6b. OFFICE SYMBOL (*If applicable*)	7a. NAME OF MONITORING ORGANIZATION ---
6c. ADDRESS (*City, State, and ZIP Code*) 4676 Admiralty Way Marina del Rey, CA 90292	7b. ADDRESS (*City, State, and ZIP Code*) ---
8a. NAME OF FUNDING / SPONSORING ORGANIZATION Air Force Office of Scientific Research 8b. OFFICE SYMBOL (*If applicable*)	9. PROCUREMENT INSTRUMENT IDENTIFICATION NUMBER F49620 84 C 0100
8c. ADDRESS (*City, State, and ZIP Code*) Bolling Air Force Base, Building 410 Washington, DC 20332	10. SOURCE OF FUNDING NUMBERS PROGRAM ELEMENT NO. --- / PROJECT NO. --- / TASK NO. --- / WORK UNIT ACCESSION NO. ---

11. TITLE (*Include Security Classification*)
Notes on the Organization of the Environment of a Text Generation Grammar (Unclassified)

12. PERSONAL AUTHOR(S)
Matthiessen, Christian

13a. TYPE OF REPORT	13b. TIME COVERED	14. DATE OF REPORT (*Year, Month, Day*)	15. PAGE COUNT
Research Report	FROM _____ TO _____	1987, April	42

16. SUPPLEMENTARY NOTATION
Presented at the Third International Workshop on Text Generation, held August 19-23, 1986 in Nijmegen, The Netherlands. [continued on back]

17. COSATI CODES		
FIELD	GROUP	SUB-GROUP
09	02	

18. SUBJECT TERMS (*Continue on reverse if necessary and identify by block number*)
artificial intelligence, functional unification grammar, grammar, linguistics, natural language, Nigel, parsing, syntax, systemic grammar, text generation

19. ABSTRACT (*Continue on reverse if necessary and identify by block number*)

One of the tasks in designing a text generation system is to organize the environment of the grammatical component of the generation system in such a way that it supports the grammatical resources in generation. This report discusses the methods used for the Penman generation system to infer aspects of the organization of the knowledge base and other components of the environment of the Nigel grammar of the Penman system. It is shown how the design task can be broken down into a number of very explicit demands on the environment. In the main part of the report, the results of application of such an approach is sketched, with particular emphasis on the general organization of the knowledge base and the discourse model parts of the environment.

20. DISTRIBUTION / AVAILABILITY OF ABSTRACT ☑ UNCLASSIFIED/UNLIMITED ☑ SAME AS RPT. ☐ DTIC USERS	21. ABSTRACT SECURITY CLASSIFICATION Unclassified
22a. NAME OF RESPONSIBLE INDIVIDUAL Sheila Coyazo Victor Brown	22b. TELEPHONE (*Include Area Code*) 213-822-1511 22c. OFFICE SYMBOL

DD FORM 1473, 84 MAR 83 APR edition may be used until exhausted. All other editions are obsolete.

SECURITY CLASSIFICATION OF THIS PAGE
Unclassified

16.
Reprinted from G. Kempen, ed., *Natural Language Generation: Recent Advances in Artificial Intelligence, Psychology, and Linguistics*, Boston/Dordrecht: Kluwer Academic Publishers, 1987.

ISI Reprint Series
ISI/RS-87-177
April 1987

University of Southern California

Christian Matthiessen

Notes on the Organization of the Environment of a Text Generation Grammar

Reprinted from
Natural Language Generation: Recent Advances in Artificial Intelligence, Psychology, and Linguistics.

INFORMATION SCIENCES INSTITUTE

213/822-1511
4676 Admiralty Way/Marina del Rey/California 90292-6695

This research was supported by the Air Force Office of Scientific Research Contract No. F49620 84 C 0100. The views and conclusions in this report are those of the author and should not be interpreted as necessarily representing the official policies or endorsements, either explicit or implied, of the Air Force Office of Scientific Research of the U.S. Government.

ISI Reprint Series

This report is one in a series of reprints of articles and papers written by ISI research staff and published in professional journals and conference proceedings. For a complete list of ISI reports, write to

Document Distribution
USC/Information Sciences Institute
4676 Admiralty Way
Marina del Rey, CA 90292-6695
USA

1. SUPPORTING A TEXT-GENERATION GRAMMAR

One of the many tasks in building a text-generation system is to design the environment in which the lexicogrammar (i.e. lexis and grammar) works. In this report, I will use English lexicogrammar to infer aspects of the organization of other parts of a text-generation system.[1] The basic question is how the environment should be organized to support the lexicogrammar.

1.1 Lexicogrammar in generation

In the generation of text, there are a number of varied communicative demands on lexicogrammar, representing different kinds of considerations. We can think of these demands as being embodied in 'messages' given to lexicogrammar for expression. Consider just the 'messages' in a text that will be expressed as clauses. For any given 'message', three general tasks have to be accomplished. (1) An action or relation has to be represented together with one or more of the entities participating in it. (2) The reader /listener has to be told what to do with the representation (e.g. agree with it as say a description of past shared experience, supply some information requested by the speaker, treat the representation as an instruction to perform the action represented.) (3) The current 'message' has to be presented in such a way that the reader can relate it to its context, e.g. the entities participating in the action/relation have to be identified to the reader. These varied demands are integrated and represented as one wording, i.e. one (linear) combination of structure and lexical items. This integration and representation is the process of **lexicogrammatical** expression in text-generation, and the resource used is the lexicogrammar of the system.[2]

1.2 Using lexicogrammar to infer other organization

Now, what I want to do is this: I will take the lexicogrammatical resources of English as a starting point, and explore what demands the resources put on the design of the part of a text-generation system that supports the process of lexico-grammatical expression. In a sense, this exploration means putting the generation process on its head. After all, in generation, communicative demands are made on the lexicogrammar; it is the servant that integrates and represents the varied communicative demands I mentioned earlier. However, I will be talking about the *design considerations* we have to take into account when we construct a text-generation system, not the flow of control during generation. The exploration is a partial solution to the problem of designing and specifying the parts of a text-generation system.

One reason for using the lexicogrammar to infer the organization of other parts of the system is that we know a good deal more about lexicogrammar than we know about the organization of other parts. In particular, we have functional accounts such as those by Halliday, other systemic functional linguists, and other functional linguists that interpret lexicogrammar as a resource in a communicating system.

It is in fact quite common to reflect English *lexical* organization in the knowledge base of a text-generation system when the domain model for a particular generation task is built. The semantic net is often a lexicosemantic net. The approach can be generalized;

we can take the grammar part of lexicogrammar as well as the lexis part into consideration when we build a knowledge base, so that it reflects not only lexical semantics but also *grammatical* semantics.

The strategy of considering what the lexico-grammatical demands for support are is somewhat analogous to what happens when we take our demands to an expert who provides services. If I wanted to build a house, I would take my wishlist to a builder, but since I'm not an expert at all myself, it is very likely that he or she would take the lead and make demands on me for information -- information I would never have thought to supply since my view of the house would be as a place to live, not as a thing to build.

In this paper, I will look at the lexicogrammatical resources statically and will consider the static distinctions needed to support lexicogrammar. I will leave the consideration of the *processes* involved in generation for another time. Furthermore, I will focus on the content of these distinctions rather than the formalisms needed to encode them; for the latter, see Nebel & Sondheimer (1986) and, for a discussion of a linguistically based functional logic, Dik (to appear). In Section 2, I will sketch a particular interface between the grammar and its environment, the inquiry interface, which can be used to project organization from the grammar to its environment. In Section 3, I will note the most general aspect of the interaction between grammar and environment, viz. the metafunctional decomposition. I will then discuss two functional components of the environment, the knowledge base (Section 4) and the discourse model (Section 5).

2. THE INQUIRY INTERFACE BETWEEN GRAMMAR AND ENVIRONMENT

In our work on the design of one particular text-generation system, Penman, we have made use of the strategy of asking what demands the grammar makes on the rest of the system. I will present some of the results of our work. We have been using a large systemic functional grammar of English, the so-called Nigel grammar (Matthiessen, 1981, 1983a, 1985; Mann, 1982, 1983b; Mann & Matthiessen, 1985). It is based on Halliday's work on English grammar, and I will rely heavily on his work in this paper (e.g. Halliday, 1985).

2.1 The environment

I will not discuss the organization of Penman here (an early architecture is given in Mann, 1983a); for our purposes, we can simply think of the Nigel part of the generator as embedded in the rest of the system, which constitutes Nigel's environment; see Fig. 1.[3] This environment includes the knowledge base of the system (both general knowledge of taxonomies of conceptual classes and instantial knowledge of particular states of affairs), plans for particular generation tasks, a dynamic discourse model, and so on. For discussions of the environment in systemic terms, see Halliday (1978) and Fawcett (1980).

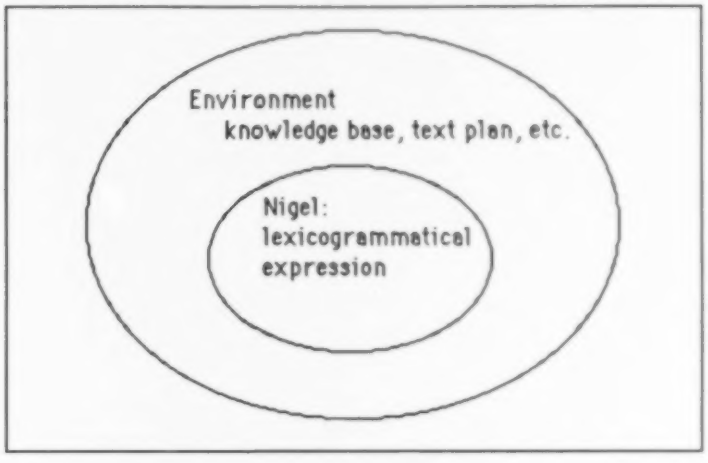

Fig. 1: Nigel and its environment

Communicative demands on Nigel come from the environment and, as we will see in the next section, Nigel demands information from the environment to achieve its task of lexicogrammatical expression. We will see how the grammar makes demands on different aspects of the environment (Section 3).

2.2 The organization of the grammar

The Nigel grammar is a systemic functional one. Systemic grammar is presented as a computational grammar in Davey (1978), Winograd (1983), Matthiessen (1983a), Mann & Matthiessen (1985), and Patten (1986) and I will only mention a few general characteristics that will indicate how the grammar can be used to infer facts about its environment. The organizing principle of systemic grammars in general is that of ***choice;*** the grammar is one large **network** of inter-related choice points, called **systems** (see Figure 2 to be discussed below). A system consists of an entry condition or input condition and a disjunction of terms or output features. The options that constitute the alternative choices are represented by **features**, the so-called terms or output features of the system. A system can be reached when its **entry condition** has been satisfied; the entry condition is the output feature from another system or a complex of output features from various other systems. It is the system network organization of the grammar in particular that has made it possible to use the grammar to explore the organization of its environment: the systems are the focal points of the interface between the grammar and its environment.

2.3 The inquiry interface between grammar and environment

In order for the generation process to make grammatical choices in a purposeful way, we have equipped each system (choice point) with a **chooser** or choice expert. The chooser of a system asks a number of questions, called **inquiries**, of Nigel's

environment, i.e. of the knowledge sources outside the grammar, to obtain the information relevant to the choice it has to make.

To generate the structure of a grammatical unit (a clause, a nominal group, a prepositional phrase, etc.), the generation procedure traverses the grammatical system network. As the network is traversed, the environment is asked one inquiry after another. Whenever a response or a set of responses satisfy the condition for choosing a grammatical feature, it is chosen . It may have a specification of a fragment of grammatical structure (a realization statement) associated with it, in which case the specification is activated. The generation of a unit finishes when the system network has been traversed. Assume the task is to generate a short biographical note and that the first part of it comes out as a clause combination: *J.G. Farrell was born in Liverpool in 1935 but spent much of his childhood in Ireland.* To produce this wording, the grammar is re-entered several times so that the system network is traversed several times. On one re-entry the task is to refer to Farrell's childhood, and the nominal group part of the system network is traversed. Nigel asks a number of inquiries of the reference plan for the nominal group.

For instance, the first system of a number of systems dealing with DETERMINATION in the nominal group (noun phrase) has two choice options, the features "definite" and "indefinite". The chooser of the system asks the environment whether the referent of the nominal group can be identified by the listener(s), i.e. whether it is recoverable, or not. If the response to the inquiry is '(YES:) IDENTIFIABLE', the chooser chooses the grammatical feature definite, which leads to further distinctions in the grammar. The interaction is represented graphically below. The circle represents the embedding of Nigel in its environment (cf. Figure 1 above). The figure shows a network fragment of three systems. If the option 'instantiable class' is chosen in the leftmost system, the system with the options 'definite' and 'indefinite' can be entered. Choosers are represented by small circles.

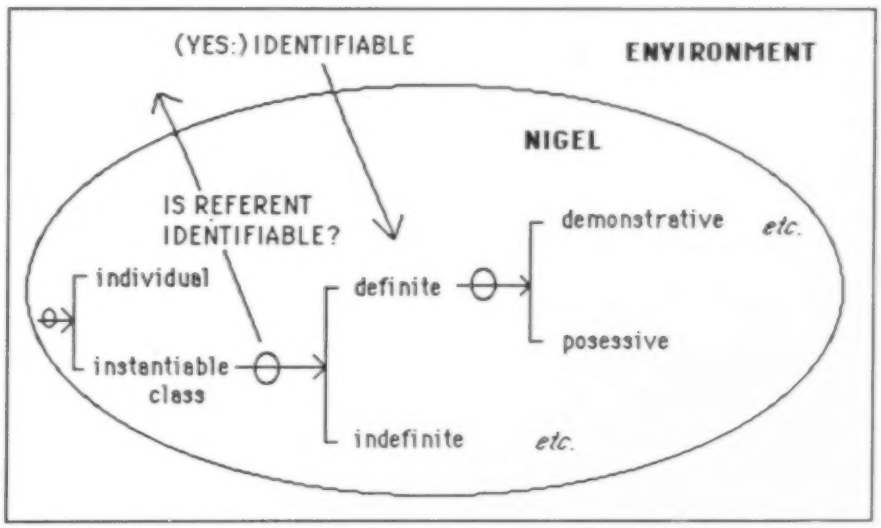

Fig. 2: The chooser of the DEFINITENESS system

The inquiry concerning identifiability is one instance of a demand on Nigel's environment. It points to the need for a dynamic discourse model in the system which can keep track of referents identifiable to the addressee and distinguish them from referents that are not identifiable. In the example of Farrell's childhood, this referent is identifiable because Farrell has already been introduced earlier in the text as a referent and his childhood can be identified by reference to him: *his childhood.*

Thanks to the chooser and inquiry framework, we now have a lot of very detailed information concerning what kind of support is needed for the grammar; there are over 250 systems in the Nigel grammar currently and the chooser of each system contains one or more inquiries, each one of which makes a very specific demand. As I have already said, I will draw on the results of examining the inquiries, but I do not intend this paper to be a detailed account of Nigel. The distinctions are needed in any large and versatile system that generates English; they are not artefacts of the chooser and inquiry framework.[4] As I proceed, I will make reference to the grammatical system network, but I will not attempt to show how every single distinction in the environment can be justified by reference to a particular inquiry.

3. FUNCTIONAL DECOMPOSITION OF GRAMMAR AND ENVIRONMENT

The most general observation about the interaction between the grammar and its environment is probably that it is functionally differentiated. We can learn something about this functional differentiation by looking at the metafunctional decomposition of the grammar.

3.1 Metafunctions in the grammar

The lexicogrammar of a language is a *functionally* organized resource. We can identify **functional regions** such as mood, transitivity, theme, modality, tense, and determination. Functional regions like these specialize four very general **metafunctions** (see Halliday 1967/8, 1973, 1978, 1985):

> **experiential**: the representation of the speaker's experience, organized in terms of experiential/ontological categories such as processes, things, and qualities. "The experiential function, as the name implies, is the 'content' function of language: it is language as the expression of the processes and other phenomena of the external world, including the world of the speaker's own consciousness, the world of thoughts, feelings, and so on." (Halliday, 1974) "The term 'experiential' makes it clear that the underlyingfunction is seen not as the expression of 'reality' or 'the outer world' but as the expression of patterns of experience; the content given to an utterance by this portion of the language system derives from the shared experience of those participating in the speech situation." (Halliday, 1967/8)
>
> **logical**: the organization of processes, etc. into very general 'logical'

relations such as addition, restatement, and modification. The logical component gives us the grammatical resources for representing phenomena as complexes, e.g. complexes of a sequence of processes.

interpersonal: the speaker's interaction with the listener, indicating how the experiential representation is intended to be taken. "Here, the speaker is using language as a means of his own intrusion into the speech event: the expression of his comments, his attitudes and evaluations, and also of the relationship that he sets up between himself and the listener -- in particular the communication role that he adopts, of informing, questioning, greeting, persuading and the like." (Halliday, 1973)

textual: the creation and presentation of the text as a text in context, fluent and cohesive for the listener; i.e., enabling the creation of text. "The textual component is concerned with the creation of text; it expresses the structure of information, and the relation of each part of the discourse to the whole and to the setting." (Halliday, 1973)

The two first metafunctions, the experiential one and the logical one, can be grouped together as the ideational metafunction, the function concerned with ideation. The first mode of ideating is experience specific, while the second is highly generalized.[5]

3.2 Functional decomposition of the environment

Each metafunction places different kinds of demands for support on a text-generation system. The experiential one is supported by the knowledge base, the interpersonal one by a model of the speaker-listener interaction which includes e.g. speech act planning and epistemic and attitudinal assesments, and the textual one by a discourse model that keeps track of referents introduced, controls topic (focus) continuity and shift, and so on. The grammar brings these different demands together, although they may come from distinct sources of reasoning. (This is what I had in mind when I said in the introduction that the lexicogrammar serves as an integrator in a text-generation system.)

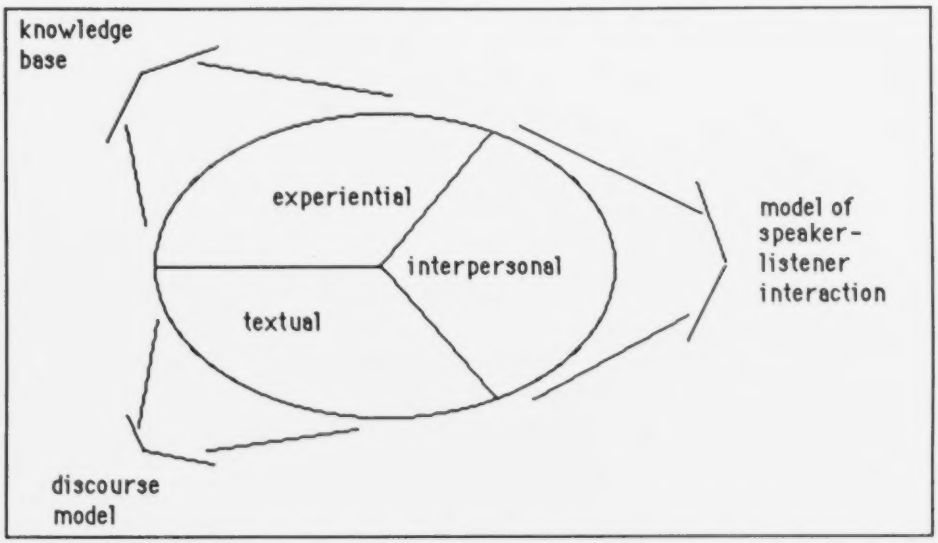

Fig. 3: The differentiation in sources of support according to function

The observation that the environment is decomposed into various knowledge sources is no news, of course; what is of interest is the correspondence between the decomposition of the environment and the functional organization of the grammar. Systemic linguists have studied the differentiation depicted in the figure in terms of correlations between the metafunctional organization of the linguistic system and the organization of the context; see e.g. Halliday (1978) and Halliday & Hasan (1985); cf. also Fawcett (1980).

In text-generation systems, it is common to find *distributed lexicogrammars*, where different functional regions are handled in different ways. For example, TRANSITIVITY may be handled by associating case frames with concepts in the knowledge base hierarchy (cf. Jacobs' (1985) PHRED, for instance). These associations are often thought of as lexical entries for verbs. MOOD and THEME are then seen as later specifications of the basic case frame information. I will now explore two of the three components in Figure 3, the knowledge base (Section 4) and the discourse model (Section 5). For a discussion of speaker-listener interaction in text-generation, see Hovy (1986) and Hovy & Schank (1984).

4. THE KNOWLEDGE BASE

The knowledge base of a text generator contains knowledge about phenomena such as episodes, procedures, events, actions, relations, circumstances, things, qualities, quantities, and so on. These can be organized in a variety of different ways, of course, but there are certain guiding principles of organization derivable from the lexicogrammar of English that will facilitate the process of generation and I will focus on these principles. When the knowledge base is viewed from this perspective, concepts can be thought of as semantic types and the knowledge base itself as a *meaning base*, to put it

in Halliday's terms. I will start with the most general categories of phenomena recognized in the knowledge base, and then move to a brief consideration of the different modes of organization that characterize the most general types. Finally, I will note correlations between different taxonomies in the knowledge base. My aim is not to be exhaustive but to bring out some aspects of the nature of what lexicogrammar can tell us about the organization of the knowledge base.

4.1 The composition of a phenomenon

The ranks and classes of the grammar constitute a very general 'theory' or interpretation of our experience of phenomena. The nature of this 'theory' has often been obscured for a number of reasons. Grammatical metaphor is often not factored; cf. the note in Section 4.4 below. Scholars have typically tried to state correspondences in terms of word classes, which is simply a continuation of the orientation towards words we find in traditional grammar, and word classes are much less helpful as a starting point than clauses and groups/phrases. Thus we find attempts to make semantic sense of the 'universe' in terms of nouns and verbs alone. Further, interpretations of grammar have often been formal and oriented towards logic and not designed to bring out the functional nature of grammar.

If we take the grammar's distinction of clause complexes, clauses, and groups/phrases and look at the kinds of inquiries that have to be asked to distinguish these, we can project upwards from the grammar and posit corresponding semantic (conceptual) types. Clause complexes represent sequences, clauses represent composite phenomena, and groups represent simple phenomena. Further, nominal groups represent participants, verbal groups represent processes, prepositional phrases represent circumstances, and adverbial groups represent circumstances or qualities:[6]

<table>
<tr><th colspan="3">SEMANTIC TYPES</th><th colspan="2">GRAMMATICAL CLASSES</th></tr>
<tr><td colspan="3">supercomplex phen.</td><td colspan="2">clause complexes</td></tr>
<tr><td colspan="3">complex phenomena</td><td colspan="2">clauses</td></tr>
<tr><td rowspan="4">simple phenomena</td><td rowspan="2">circumstances</td><td>prepositional</td><td>phrases</td></tr>
<tr><td>adverbial</td><td rowspan="3">groups</td></tr>
<tr><td>participants</td><td>nominal</td></tr>
<tr><td>processes</td><td>verbal</td></tr>
</table>

Fig. 4: Grammar and the basic semantic (conceptual) phenomena

These are the default ways of expressing the different kinds of phenomena. There are marked ways of coding phenomena in addition to the default strategies given in the table above. These are usually metaphorical. For example, a composite phenomenon may be coded by a nominal group, which is a metaphor of a complex phenomenon treated as if it was a simple one (e.g., *The terrorist assaults were followed by more U.S. reprisals*). I will return briefly to metaphors after the main discussion, but will not focus on them; they are discussed in some detail in Halliday (1985).

The most general consideration in the taxonomy of phenomena introduced above is composition. Phenomena are simple ('simple phenomena': participants vs. processes vs. circumstances), composites of more than one phenomenon ('composite or configurational phenomena' or 'macro-phenomena'), or composites of composite phenomena ('supercomplex phenomena' or 'sequences'). The three ranks of phenomena are organized according to different principles:

- Supercomplex phenomena are organized as sequences of interdependent composite phenomena related causally, temporally, spatially, or by some other type of a small set of highly generalized relations.

- Composite phenomena are organized as configurations of unique parts: a process, participants involved in it, and attendant circumstances.

- Simple phenomena are non-composite, elemental: participants, processes, and circumstances.

As a rank-based taxonomy, this can be compared to oragnizations such as crystal - molecule - atom (except that sequences are not organized like crystals!).The three general semantic (conceptual) types and their subtypes are displayed below. The subtypes are discussed in e.g. Matthiessen (1986) and Moore & Arens (1985).

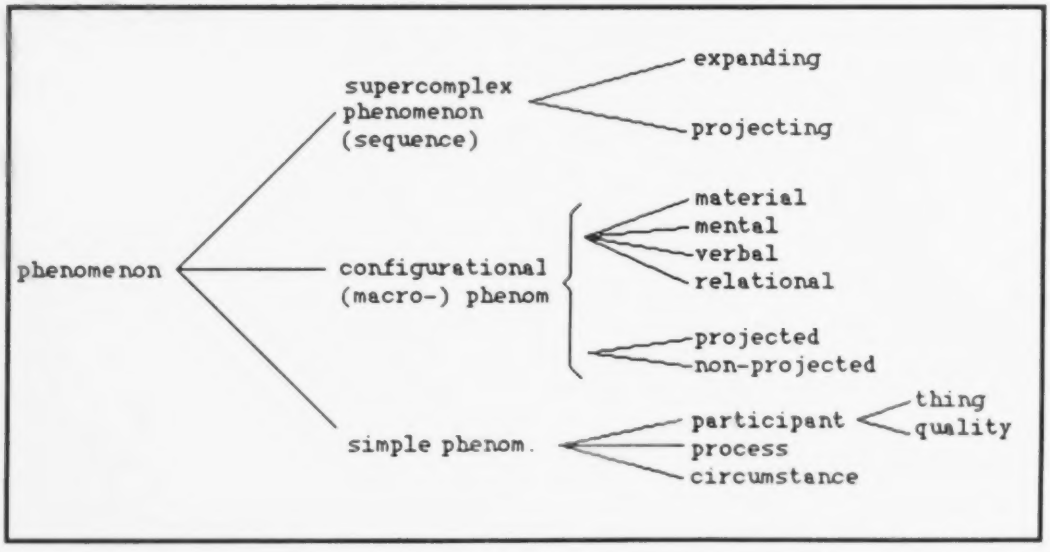

Fig 5: Most general semantic (conceptual) types

The concepts are organized into an inheritance hierarchy. For example, 'thing' is classified under 'phenomenon' as a subtype; it inherits whatever attributes 'phenomenon' has.

The most general distinction is, as just mentioned, based on considerations of composition or complexity. To simplify, the basic question is "how big is the phenomenon?". And the answer is in terms of a scale from micro to macro: phenomena are simple ones, macro-phenomena, or supermacro-phenomena. We might have based the taxonomy on another very fundamental distinction based not on size but on order of existence: "does the phenomenon exist in reality or does it exist symbolically?". And the answer would have been in terms of a distinction between phenomenon and meta-phenomenon. This distinction is, in fact, incorporated into the taxonomy of semantic types above as the distinction between projected (ideas, facts, sayings) and non-projected (acts): projected configurations are metaphenomena and all other phenomena are ordinary and 'non-meta'.

4.2 Types of ideational organization

The distinction between sequences and configurational phenomena in Fig. 5 above was characterized in terms of 'size': configurations are complex and sequences are supercomplex. At the same time, they differ in their modes of organization and the difference correlates with the differentiation between the two subtypes of the ideational metafunction, the logical subtype and the experiential subtype (see Halliday, 1979):

logical --- sequential

experiential --- configurational

4.2.1 Logical: the sequential organization of supercomplex phenomena

Supercomplex phenomena are sequences or chains whose links are composite phenomena. Sometimes these sequences are episodes with only two links. For example, a causal chain may have cause and effect as links or condition and consequence. But, more generally, a sequence may extend indefinitely, because it is organized as a chain of interdependent links and not as a configuration of a unique set of parts. To anticipate the presentation of complex phenomena, they are organized as configurations with a unique set of parts. A certain subtype of configurations organize an episode temporally as consisting of three unique parts: the temporal relation, and the two events related. Consider the following representation of a temporal episode as a configuration of two events with a coding of the temporal between them as *follow* in one clause[7] --

The terrorist assaults were *followed* by more U.S. reprisals.

The configurational organization is diagrammed below, with the three parts 'relation' and the two events related simply labelled '1' and '2'.

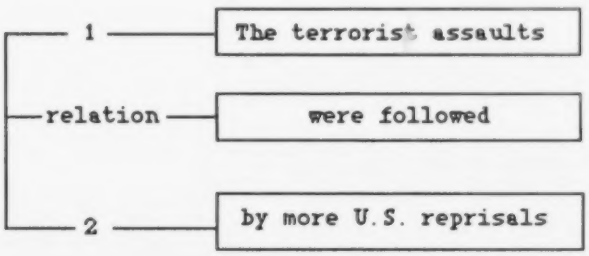

Fig. 6: Representation of a configuration

Now contrast it with the representation of a supercomplex phenomenon as a sequence by means of a clause complex rather than as a configuration. The following examples are both substeps in procedures:

> If the rotor is not pointing to the mark, pull the distributor part way out, turn the rotor some, and reinsert the destributor until the rotor point to within a half inch of the mark.
>
> Add the remaining ingredients, stir to coat the chicken well and continue until a thick sauce has formed and the chicken is tender.

The organization of the second sequence can be diagrammed in Figure 7. The interdependency relations linking the units in the chain are marked by arrows between pairs of links. The phenomenon diagrammed in the figure is organized as a temporal sequence ('and [then]') of three process configurations, 'add', 'stir', and 'continue to stir', two of which are further expanded purposively ('[in order] to') and temporally ('until'). The temporally related unit is itself an additive sequence ('and [also]'). The sequence might have been expanded further, since it is organized as a chain of interdependent units; and in this respect it contrasts with the configuration in Fig. 6 above. (Although sequences are dynamically expandable, they may be 'institutionalized' as scripts applicable in specific situations.)

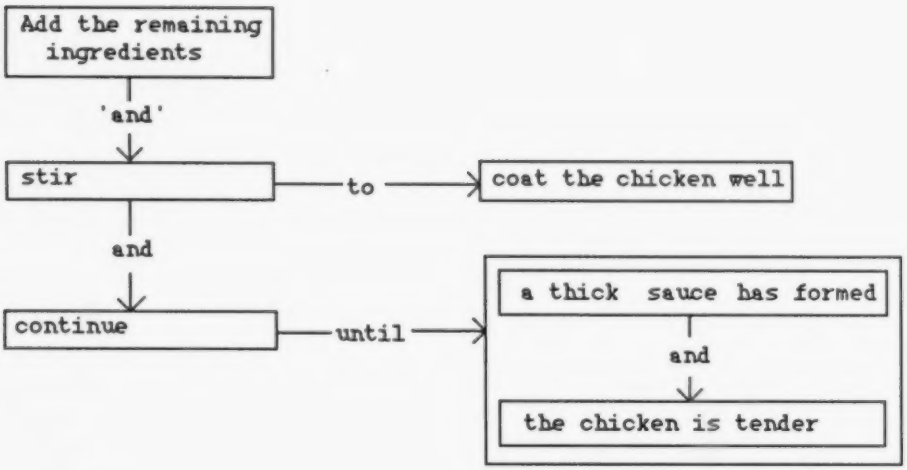

Fig. 7: Representation of a supercomplex phenomenon

4.2.2 Experiential: the configurational kind of organization of configurations

As already mentioned, a complex phenomenon is a composite configuration of a limited set of parts with unique values in relation to the whole configuration. The parts of a given configuration are a nuclear process, one to three different kinds of participants taking part in the process, and up to around seven different kinds of circumstances associated with it. (Both participants and circumstances have been discussed extensively in terms of (deep) cases in linguistics and computational linguistics, but usually without a distinction between the two. The process is typically not given a deep case.) Participants are inherent in the process; they bring about its occurrence or mediate it. There are a number of specific ways in which a participant may take part in a process; it may act out the process, it may sense it, it may receive it, it may be affected by it, it may say it, and so on. The different configurations of participants are the bases for a typology of process types, to be sketched below in Section 4.3.1. The distinction between participants and circumstances is a cline rather than a sharp division, but is semantically quite significant. Circumstances are typically less closely associated with the process and are usually not inherent in it. They specify the spatial or temporal location of the process, its extent in space or time (distance or duration), its cause, the manner of its occurrence, and so on.

Grammatically, the nuclear process, its participants, and its circumstances are typically represented as constituents in the transitivity structure of a clause. For instance, a particular process of awarding may be represented as having a Time (*in 1966)* , an awardee or, in more general terms, a Recipient (*he*), and a commodity awarded or, more generally, a Goal (*a two-year Harkness Scholarship*):

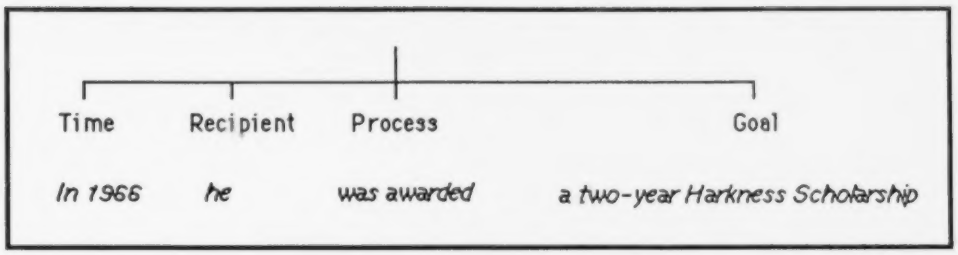

Fig. 8: The transitivity structure of a clause

In logic, configurations are reflected in the predicate - argument structure of predicate logic. The process typically comes out a predicate and the participants as its arguments. However, there are significant differences between the way a configuration is represented in predicate logic and the way it is represented grammatically in English. In knowledge representation, a configuration is typically represented as a concept frame with a number of roles (slots; as in Brachman's KL-ONE; e.g. Brachman, 1978; Brachman & Schmolze, 1985). Configurations can be represented in two ways by means of such a frame.

(i) The configuration itself may be taken to constitue the frame (cf. for example the treatment in Anderson, 1983: chapter 3), much as in the grammatical constituency diagram in Fig. 8 above. The process is represented as a role (slot) in the frame in the same way as participants and circumstances:

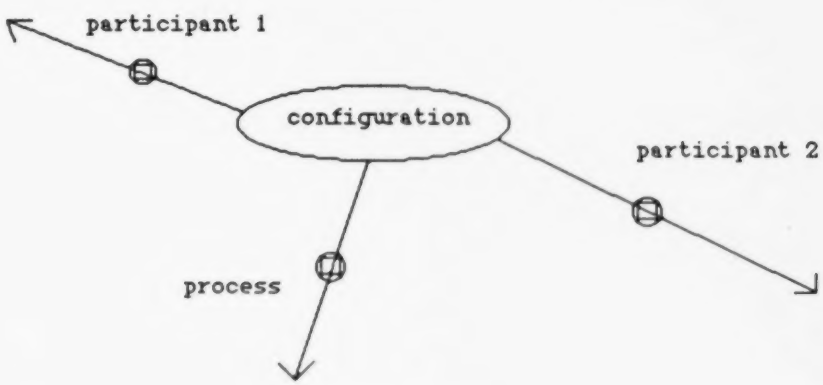

Fig. 9: Configuration as frame

(ii) Alternatively, the process part of the configuration can be treated as the frame rather than one of the roles of the frame:

Fig. 10: Process as frame

In either case, the roles have restrictions on what concepts they can be, so-called value restrictions. They are themselves concepts from other parts of the conceptual taxonomy not included in the figure. The two representations make different claims about a configuration, of course. In particular, the first approach allows the process to be a role that is filled by another concept frame that may have its own internal organization. The process part of a configuration may in fact have internal organization. At the same time, the second approach is simpler and it may be sufficient for many generation purposes.

4.2.3 Type of knowledge and knowledge representation

The frame-based representation exemplified by the KL-ONE family of knowledge representation is reasonably good at (static) experiential knowledge since the experiential principle of organization is configurational and a configuration can be represented by means of a concept frame. However, it is much less well suited to the logical subtype of the ideational metafunction (Section 4.2.1) and to the other two metafunctions. For example, the following kinds of knowledge are problematic and require additional devices such as partitioning and spreading activation:

- logical: sequences and collections of configurations.

- interpersonal: modality (possibility, probability, permission, etc.), cognitive assessment (belief, doubt, etc.), affective assessment, key (contradiction, reservation, assertion, etc.), and so on.

- textual: identifiability, thematicity, newsworthiness, etc.

4.3 Correlations between taxonomies in the knowledge base

The taxonomies of sequences, configurations, and simple phenomena are not independent of one another, of course. The roles of a configuration are restricted to be filled by particular types of simple phenomena. If we use the first approach to

representing a configuration (Fig. 9), we can see that the three kinds of roles a configurational frame is made up of, (i) the process role, (ii) participant roles, and (iii) circumstance roles, each has a default filler from the hierarchy of simple phenomena, processes, participants, and circumstances respectively; see Fig. 11.

The taxonomy of configurations is based largely on the nature of the particular types of the general process, participant, and circumstance roles. Configurations, just as concepts in general, are thus organized into an inheritance hierarchy and the subtypes of the configuration frame classified under it inherit its role configuration.[8] Each new step in the taxonomy of configurations is likely to correlate with a step in the taxonomy of simple phenomena. I will give some examples below.

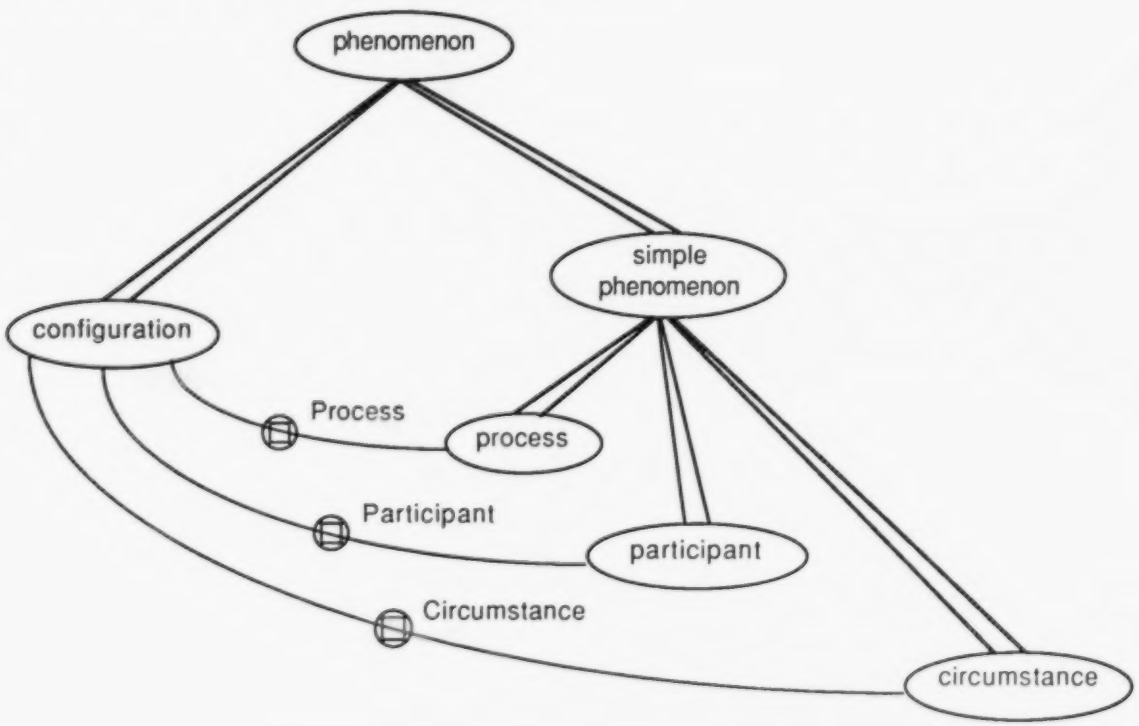

Fig. 11: Configuration with role types and role fillers

4.3.1 Configuration types

There is a small number of configuration types that can be recognized on various grounds: material, verbal, mental, and relational.[9] Since they are always reflected in the nature of the process part of a configuration, they are called process types. These and their most immediate subtypes are given in Figure 14 below. (Although we are likely to find reflections of these general types in many languages, perhaps all, it is important to emphasize again that the taxonomy is based on English. It would look different if we tried to accommodate Tagalog transitivity , for example; see Martin, 1986.) The four major types can be glossed as follows.

• *material:* doings or happenings; some input of energy is needed for the process to take place.

• *mental:* sensing by a conscious being of a phenomenon; the sensing is inert on the part of the conscious being rather than active.

• *verbal:* saying by some kind of signal source; the saying may or may not be actively performed by the signal source depending on its nature.

• *relational:* being or having; in the limiting case it is is the existence of one participant, but it is almost always a relation between two participants.

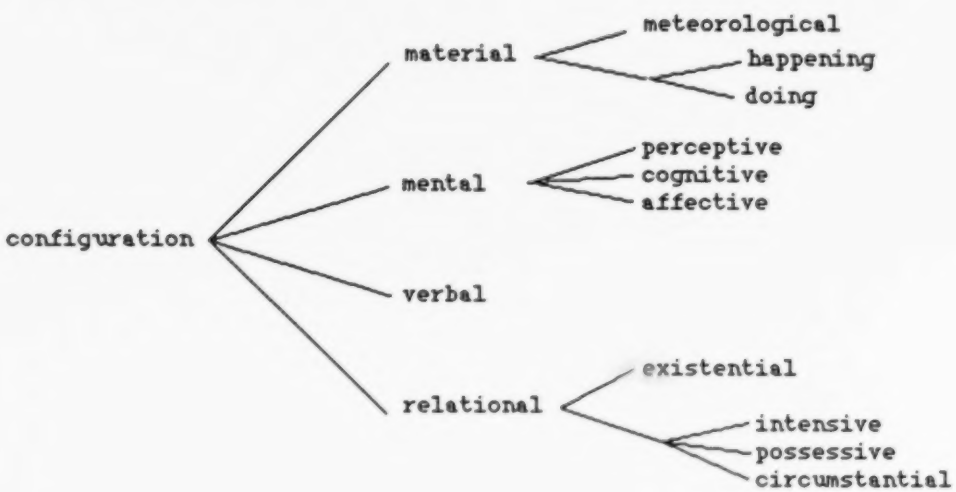

Fig. 12: Organizational types of configurations

Each process type has its own set of roles with particular value restrictions and number restrictions (Figure 13). For example, material configurations have an Actor which is a thing (rather than any kind of phenomenon). Meteorological configurations have no Actor, which is allowed by a number restriction associated with Actor, (0,1), where the first number is the minimum number of Actors and the second is the maximum one. In contrast, mental configurations do not have an Actor but a Senser, which is value restricted to 'conscious being', and a Phenomenon, which can be almost any kind of phenomenon.

The process types are reflected in the grammar of transitivity. The most general TRANSITIVITY distinctions are grammatical rather than lexical. That is to say, they have general structural consequences; they determine the number and the nature of participants that are present in the clause.[10] The four transitivity types are set out in

Figure 14 below, with one example for each type. The structure of a material clause was illustrated above for the process of awarding (Figure 8).

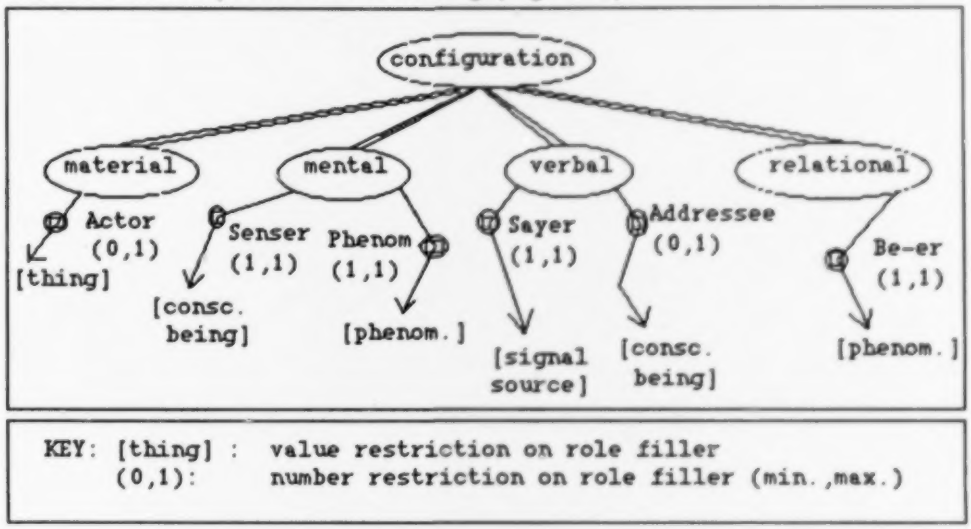

Fig. 13: Subtypes of processes in the concept hierarchy

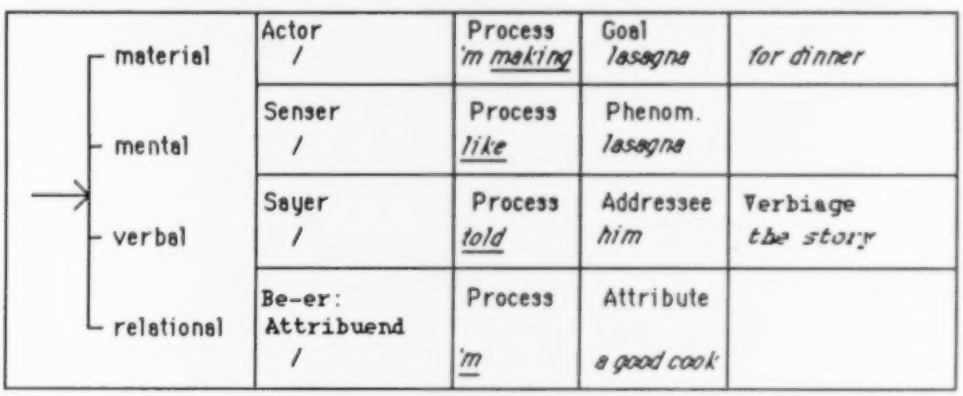

Fig. 14: The most general options in the TRANSITIVITY grammar

4.3.2 Participant types

The value restrictions in Figure 13 indicate some of the correlations between the two hierarchies of configurations and participants. There are two kinds of participants, things and qualities. Things can fill any participant roles in a configuration, but qualities are much more restricted. In effect, they can only occur as Attributes, either in ascriptive relational configurations or in material configurations denoting the result or condition of the performance of the Process.

```
This is [Attribute:] delightful (relational)
until the mixture becomes [Attribute:] thick (relational)
Serve [Attribute:] hot (material)
It can be eaten [Attribute:] raw (material)
```

Moving down the participant taxonomy to further subtypes, we can establish another correlation with the taxonomy of configurations. The Senser of a mental configuration is value restricted to be a a conscious being. Based on this value restrictionsand other considerations, we can posit a fundamental distinction between conscious beings and non-conscious beings:

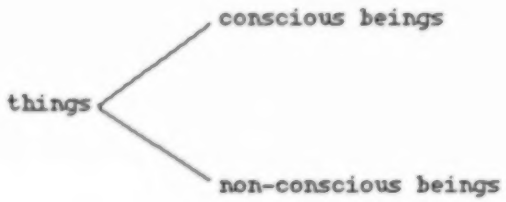

Fig. 15: Some types of things

Once we have posited the distinction between conscious beings and non-conscious beings, we find that it supports demands made in the area of reference. It is also reflected in the pronominal resources of the nominal group, in the choice between *he/she* and *it; who* and *which,* and so on.

This kind of interaction between the taxonomy of participants and the taxonomy configurations is an illustration of the very general principle mentioned above: There are groupings of kinds of processes and kinds of things. As Halliday has observed, the tightest restrictions tend to occur between the process and a particular participant, the medium. (The Medium (or "Affected") is general across the four process types; it is the participant through which the process is instantiated as a process. It is explained in e.g. Halliday, 1967; 1967/8; 1985.) For example, we find this in the area of processes of 'sounding' by animals: bark + dog, neigh + horse, moo + cow, and so on. Hasan (to appear) unravels correspondencies between e.g. processes of collecting and things.

4.4 Metaphor

The taxonomy as discussed up to this point represents the basic outline of semantic (conceptual) types. It can and should be elaborated by adding further detail. It could be extended by adding further subtypes at particular nodes. However, there is another more radical way of expanding the taxonomy by recombining semantic types that are taxonomically distinct. This happens through the strategy of metaphor. One type is

semanticized (conceptualized) as if it was another type. For example, in the final analysis, anything can be conceptualized (semanticized, and hence grammaticalized) as if it was a thing. We find qualities as things and processes as things; i.e. nominalizations grammatically speaking: *creation, destruction, protection, grammaticalization,* etc.. But we do not find things as processes; a verbalization does not entail a metaphor as a nominalization does (see Hopper & Thompson, 1984). Nouns turned into verbs typically denote a general process plus a specification of the class of one of its circumstances, e.g. *bottle* 'put ... into a bottle', *ship* 'send by ship', *finger* 'to touch etc. ... with fingers', and so on. One of the most common kinds of metaphor was illustrated in Section 4.2.1: a sequence is treated as if it were a configuration.

5. THE DISCOURSE MODEL

We now move from the experiential world view embodied in the knowledge base to the textual world view embodied in the discourse model. The textual 'world view' is ever-changing; it changes as the text and its context evolve: what was new becomes old, what was rhematic becomes thematic, was non-identifiable becomes identifiable, and so on. By nature, the textual metafunction is dynamic rather than static like the experiential one: it is concerned with the ongoing presentation of the text. (A 'rose' is a 'rose', but 'it' is not necessarily 'it'!) For example, from a textual point of view, things are instantiated referents, not classes in an experiential taxonomy.

The textual component in the grammar demands information about a number of distinctions, in particular thematic vs. non-thematic (THEMATIZATION), given vs. new (INFORMATION), and identifiable vs. non-identifiable (DETERMINATION), but these are not part of elaborate taxonomies of textual distinctions. Thus, the textual function contrasts with the experiential one, which organizes the elaborate taxonomies. Although CONJUNCTION draws on an elaborate taxonomy of rhetorical relations, these relations are not unique to the textual metafunction but can be coded experientially as well. What the textual metafunction requires are procedures for managing the presentation of information as identifiable or non-identifiable, and so on. In Section 3.2, I simply referred to these procedures as a discourse model.

One important aspect of this dynamic model is a plan for the organization of the discourse (text) itself in terms of Rhetorical Structure Theory (Mann,1984; Mann & Thompson, to appear a, b) or a comparable rhetorical strategy. The textual resources in the grammar do a lot of the work involved in realizing this plan:

> THEME selection is guided by the method of organization that is operative at any given point in the unfolding text. For example, if the text is being organized temporally, temporal themes are typically selected.
>
> The resources of CONJUNCTION are used to mark the rhetorical relations being used to organize the text, relations such as elaboration, temporal sequence, and contrast.

The resources of DETERMINATION are employed partly to indicate shifts in stages in the organization of the text. For example, paragraph initial references to a particular referent tend to be different from subsequent references.

I will now explore these three resources in some more detail, noting what they require of our discourse model.

5.1 Controlling context and THEMATIZATION

Before characterizing Theme, I will indicate what the thematic options are in the clause. Part of the grammar of THEMATIZATION (or THEME, for short; the selection of the Theme(s) of a clause) is set out in the diagram below, with examples in the column to the right. It includes only experiential themes. The default Theme is the Subject in a *declarative* clause. (The VOICE options in the grammar determine which participant is the Subject.) The non-default Theme is a circumstance or participant other than the one in the Subject role. There may be more than one non-default Theme: *In 1966, in Oxford, he was honoured by his peers.*

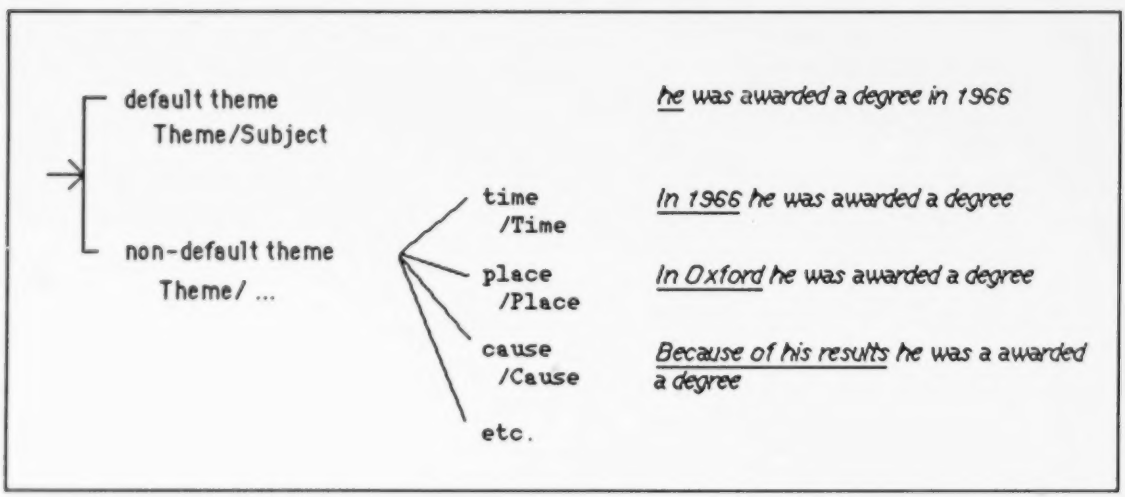

Fig. 16: Part of the grammar of THEME

The selection of the Theme of a clause determines its local context. Theme has been glossed as 'starting point of the clause as message', 'context', 'frame', 'setting', or 'orientation'. (These glosses are not formal definitions, but are only intended as ways of thinking about the category of Theme.) In English, it is expressed by initial position in the clause, as in the following example (Theme in italics):

> *On March 27, as President Reagan departed for a working vacation at his secluded mountain-top ranch,* he applauded the Senate's approval of a bill for $100 million to aid Contra forces in their struggle against the Managua government.

A week previously, the House voted down the proposal for new aid to the Contras. Congressional opponents of the anti-Sandinista force contend the group is ineffective.

(The Desert Sun, 5/iv/86)

In this extract, the Themes are non-default. They are times and they have been chosen to show the temporal organization of this span of text. The first orienting context is a date, *on March 27,* and the second relates to it and changes the temporal context to one week earlier. There is an important generalization to be made here: Fries (1983) has shown that Theme is selected to bring out the method of development of a span of text. Methods of development include organizations that are temporal (as in the example above), spatial, lists, general to specific, object to attributes, object to parts, and compare & contrast (cf. Danes, 1974).

What is needed to support the selection of Theme is an account of text organization in the generator. More specifically the discourse model must

- keep track of the changing context of each new message; and
- identify which aspect of the context relates to the method of development.

Fairly few generation systems have addressed these needs, either because they are single-sentence generators or because the domain (field of knowledge) gives the text its organization. In texts that define or describe an object, e.g. in entries in dictionaries and encyclopaedias, the the organization is often centred around the object being defined or described. After it has been introduced, the class it is a subtype of is mentioned, its attributes are identified, and subparts are specified. The Theme is likely to be the object itself throughout the text; in descriptive texts, the Theme is often also the 'topic' or 'subject matter' of the description. Further, the Themes are likely to be default ones, i.e. they are likely to be Subjects. McKeown's TEXT system generates texts that define objects and compare and contrast objects (McKeown 1982) and the Themes are also the Subjects of the clauses, the default choice. TEXT keeps track of the topic (called focus by McKeown) and can change the topic. The method might be extended to e.g. spatial and temporal contexts.

For Penman, the general theory of text organization mentioned above, Rhetorical Structure Theory, can be used to support reasoning about the local context. The rhetorical plan for a text specifies how a particular message or cluster of messages is related rhetorically to the rest of the text and this relationship can be thematized. For example, if one segment contrasts with another segment, the point of contrast can be thematized.

Before I leave the area of THEME, I'd just like to point out that the notion of Theme (opposed to Rheme) is distinct from the notion of New (opposed to Given); see Halliday (1967/8, 1985); and Fries (1983). New belongs to the functional region of INFORMATION. It is realized by intonational prominence; it is thus a category of spoken

English. However, in the default case, the intonational prominence comes at the end of the clause, so there is a default association between final position in the clause and New. The meaning of New is discussed in e.g. Halliday (1985: ch. 8); it can be glossed as "attend to this; this is news". It is a strategy for directing the listener's attention to the news of the current message. Again, this is a textual strategy that requires a dynamic model of the addressee.

5.2 Rhetorical relations and CONJUNCTION

Theme sets up the local context of a clause; the context may be specified interpersonally, experientially, or textually. The textual context of a clause is its rhetorical relation to preceding text as specified by CONJUNCTION; the resources of CONJUNCTION are used to mark rhetorical relations in a text (elaboration, addition, alternation, contrast, temporal sequence, simultaneity, reason, and so on: see Halliday and Hasan, 1976; and Martin, 1983.). For example, alternation is often marked in recipes:

> Fry some onions, mushrooms and sweet peppers in butter. Stir in some cooked macaroni and a chopped hard-boiled egg for each person. Moisten well with cheese, tomato or herb sauce and finish as for macaroni cheese. *Alternatively,* the macaroni may be served without the sauce, sprinkled with cheese only.

Like THEMATIZATION, CONJUNCTION needs the support of an account of the rhetorical organization of the text. There have been accounts of specific relations in past generation systems. For example, Davey's Proteus system looked for and expressed contrast between actual and possible moves in the game commentaries generated (Davey, 1978). But not general account that will support CONJUNCTION in generation has been put forward yet. Such support should be provided by Rhetorical Structure Theory. In addition, there has to be an account of when to make a rhetorical relation explicit by using a conjunction and when to leave them implicit.

By looking at the resources of CONJUNCTION, we can determine a number of characteristics the discourse model must have:

(i) it must control the full range of conjunctive relations;

(ii) it must support external organization of text as well as internal organization;

(iii) and it must handle pairs of *clusters* of messages to be related conjunctively in addition to pairs of single messages.

(i) The conjunctive resources include not only simple additive, disjunctive, temporal, and causal relations, but also more complex relations such as addition with reinforcement (*again, furthermore, moreover,* etc.), dismissive relations (*anyhow, at any rate,* etc.), resumptive relations (*to resume, to return,* etc.), verificative relations

(*actually, in fact,* etc.), distractive relations (*incidentally, by the way,* etc.), and interpretive relations (*that is, I mean,* etc.). These relations indicate among other things that the discourse model must be able to leave one context, work within a new context, and then return to the old one.

(ii) CONJUNCTION also points to a very general principle of text organization. Conjunctions are external or internal, which reflects the fact that text can be organized according to a sequence of events external to the text itself or it can be organized according to the sequence of the rhetorical acts of speaking that constitute the text and thus are internal to it. External and internal development may used one by one or together. The distinction is discussed and exemplified in Halliday & Hasan (1976).

(iii) A conjunction may relate two simple messages, as in

> Leave to set, *then* fry in deep fat or oil until a golden brown.

but it may also relate a sequence of messages to another sequence:

> Pour on to the hot butter and cook gently until the bottom is set and light brown. *Then* either place in a warm oven at 300-350° F., M2-4, until the omelette is set, or place under medium grill and cook until the top is nicely browned.

In fact, this observation takes us back to Section 4.2.1 and the organization of supercomplex phenomena as sequences: texts are typically supercomplex phenomena and the discourse model has to be able to handle the kind of internal nesting we often find in sequences.

5.3 Identifiability etc. and DETERMINATION

In the clause, THEMATIZATION determines the thematic status of participants and circumstances (thematic vs. rhematic). In the information unit in spoken English, INFORMATION determines their information status (given vs. new). These textual statuses are independent of but clearly related to a third textual status, the identifiability status of referents, which is controlled by DETERMINATION in the nominal group.

In the experiential perspective, a thing is a general class, possibly with subcategorizations and descriptive attributes. The textual perspective on a thing is concerned with the instantiation of the class; with the thing as a referent. Both perspectives are integrated in the nominal group. DETERMINATION is the grammatical resource for indicating how the class is instantiated as a referent or a set of referents; whether the instantiations are identifiable or not, and so on. The most general DETERMINATION choices are given in the network fragment below in Figure 17. Determiners are used with lexical nouns, as in *the terminal.* But we find the same kind of distinctions among pronouns as among determiners.

Like THEMATIZATION, DETERMINATION depends on a dynamic model of the context, in particular of the addressee / reader. In this dynamic reader model, it has to be possible to determine whether a given referent is identifiable or not (cf. Figure 2 above in section 1.4) to the reader. Non-identifiable determiners in particular overlap in coverage with the quantifiers of formal logic, but the distinctions are not the same.

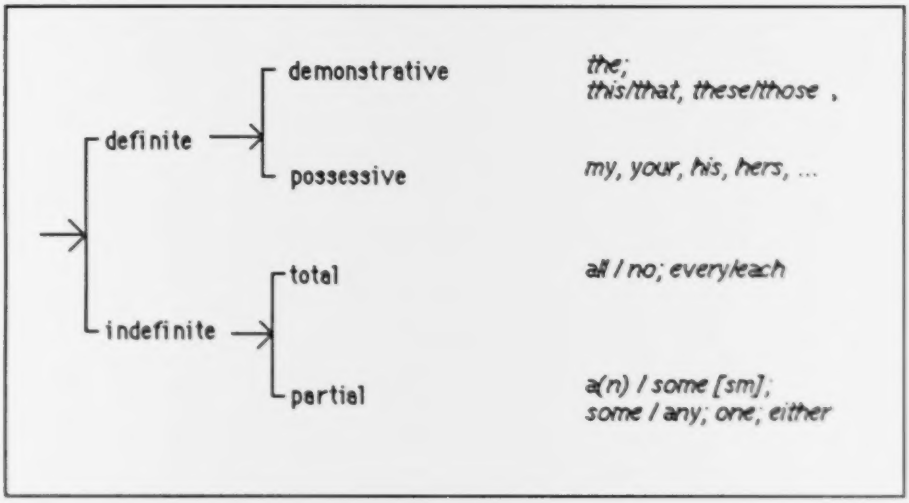

Fig. 17: The most general DETERMINATION systems

I will discuss **non-identifiable** determination first, using the interpretation given in Halliday (1985: 161) and elaborating on it. Non-identifiable determination is not concerned with how to identify an already established instantion but with the instantiation of a potential discourse referent -- with how a class is instantiated: whether it is instantiated completely or only partially, whether it is instantiated selectively or not, and so on. The general distinctions are the same for both singular instantiations and non-singular (i.e., mass or plural) ones. The most general distinction is between an instantiation of the whole class, total instantiation, or only a a subset, partial instantiation. What the whole class is really depends on the context. The total determiners include *all* and *no* (non-singular) and *every/each* (singular). The latter are segregatory; they indicate an iteration over each instantiation of the class rather than an instantiation of the class as an undifferentiated whole:

> *All* language courses are designed to a specific purpose and in this sense can all be said to be directed at specific purposes.
>
> If purpose is interpreted simply as what people need to do with their language then there will of course be a whole host of different purposes associated with various universes of discourse, types of interaction and so on, and *each* will yield a different description.
>
> (Widdowson, Learning Purpose and Language Use)

The partial determiners include (i) selective *some* (pronounced [sAm]), *any* , *one;* and (ii) non-selective *some* (pronounced [sm]) or the lack of a determiner, and *a(n).* (i) The first set indicates that the instantiation of the class is selective; the manner of the instantiation matters. The selection is either restricted (*some, one*) or unrestricted (*any*). For instance (ESP is English for Specific Purposes):

> By objectives I mean the pedagogic intentions of a particular course of study to be achieved within the period of that course and in principle measurable by *some* assessment device at the end of the course.
>
> Now in *some* kinds of ESP, training, as I have defined it, may well be appropriate, ...
>
> The problem for *any* ESP course design is to find its place on the continuum.
>
> (op cit.)

(ii) The second set does not give any information about the selection in the instantiation; what is important as far as the determination goes is just the number of the class instantiated (singular or non-singular):

> I am suggesting, then, that as generally conceived, ESP is *a* training operation which seeks to provide *0* learners with *a* restricted competence to enable them to cope ...
>
> (op cit.)

The distinctions are tabulated below in Figure 18.

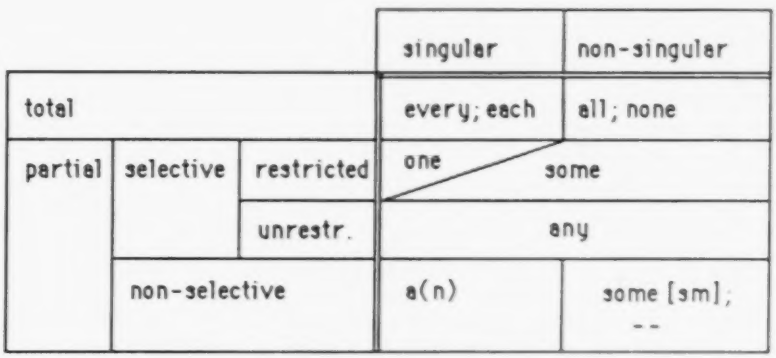

Fig. 18: Non-identifiable DETERMINATION (excluding *either; both*)

Now I will turn the **identifiable** case. The different sources of identifiability are diagrammed in Figure 18 below.

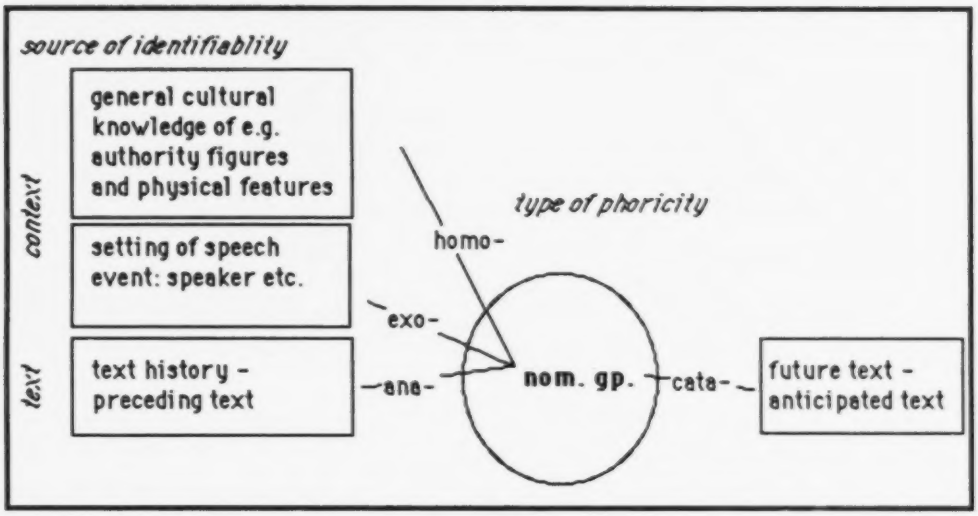

Fig. 19: Sources of identifiability

A simple **anaphoric** case of identifiability is not too hard to handle in generation: the referent has just been introduced in the text and has thus been established by the text itself as identifiable (anaphoric reference: e.g. *Farrell ... he*). However, a referent can be identifiable by virtue of standing in one of a small set of relations (e.g. part-whole) to a previously mentioned referent without having been mentioned previously itself (so-called bridging: *Leeks have one fault. Because they are blanched the stem seems to accumulate ...*), by virtue of being part of the setting of the speech event (**exophoric** reference: *Rock Cakes. Heat the oven to 425 ^{o} F.*), by virtue of being part of shared cultural knowledge (**homophoric** reference: *the sun, the boss, the queen*), by virtue of an anticipated future mention in the text (**cataphoric** reference) and so on (cf. Halliday & Hasan, 1976; Rochester & Martin, 1977).

A general account of identifiability has not been incorporated into any text-generation system yet. In addition to a dynamic reader model, the account will have to rely on the text organization for some kind of notion of paragraph, since different ***strategies*** are often used for referring to an identifiable referent depending on whether it is paragraph-initial or not (cf. Hinds, 1977; Fox, to appear; cf. also Givón, 1983, on referring strategies and topic continuity). Here is an example from a news item. Two strategies are used, pronouns (underlined) and individual (proper) names (italicized), to refer to Marcos:

> *Former Philippines President Ferdinand Marcos* says the United States aided rebel military forces against him in the final hours of his regime, with Americans refueling and rearming helicopters that attacked his presidential palace.
>
> In an interview on Friday night's broadcast of ABC's "Nightline," *Marcos* also denied stealing or misappropriating

> money from his country, said he still considered himself president of the Philippines, and defended his wife's collection of 3,000 pairs of shoes.
>
> A partial transcript of the interview was released by ABC News Friday night and portions were broadcast on "World News Tonight."
>
> *Marcos'* 20-year rule ended Feb. 26 when he fled the country after a popular uprising ...
>
> (The Desert Sun, 5/iv/86)

Further, the knowledge base has to be organized in such a way that the relations that are used in bridging are supported.

The types of phenomena in Fig. 4 define possible types of referents. Among them, definite pronouns can be used to refer to participants, of course. But the referents of *this, that,* and *it* (cf. also relative *which*) can be extended in two ways, which correspond exactly to the two perspectives we can put on phenomena: 'size' - from micro to macro-phenomena and order of reality - from phenomena to meta-phenomena (cf. the end of Section 4.1). (i) They can be extended literally from micro to macro, from simple phenomena to complex phenomena, which is called extended reference. (ii) They can also be extended metaphorically from phenomena to metaphenomena; they can be used to refer to facts, called text reference. Halliday & Hasan (1976) give an account of extended and text reference and offer the following example to bring out the difference:

> It rained day and night for two weeks. The basement flooded and everything was under water. *It* spoilt all our calculations.

The example is ambiguous and the ambiguity resides with the pronoun *it,* which refers either to the macrophenomenon of raining and flooding, in which case the calculations are physical records, or to the metaphenomenon, the fact that it rained, in which the calculations are forecasts of the weather. The resolution of this ambiguity has brought us full circle to Section 4.1 where I began the discussion of the knowledge base and the discourse model.

6. CONCLUSION

In this report, I have given a selective overview of what kinds of support the lexicogrammar of a text-generation system needs. I have focused on static distinctions that have to be made in the system, rather than on the processes involved in generating text, and have presented them in terms of Halliday's metafunctions. An account of the processes involved would have to include the selection of relevant information in the knowledge base, the planning of the speech acts to be performed, and the planning of

the rhetorical organization of the text. Furthermore, I have focused on the content of the distinctions rather than on the notations or formalisms needed to deal with them.

What is needed as this point is really a more detailed treatment, not a summary; this paper is a very sketchy summary itself. However, I will put the discussion in a summary perspective by way of one example, in which I consider what is needed to support the generation of (5) in the excerpt below, just in terms of clause structure. It is taken from the short biographical note in one of the novelist Farrell's books, parts of which have already been used for illustration.

> (1) J. G. Farrell was born in Liverpool in 1935 but (2) spent much of his childhood in Ireland. (3) After leaving Oxford (4) he taught English in France for several years. (5) In 1966 he was awarded a two-year Harkness Scholarship. [...]

So let's assume we want to generate a 'message' (cf. section 1.1) according to the following specifications:

> [i] **Discourse model**: The message should be temporally contextualized so that it orients the reader to a particular time in Farrell's biography. Furthermore, it should present Farrell as a topical referent that has already been introduced at this point in the text.
>
> [ii] **Knowledge base:** The message should represent the particular event in Farrell's life in which he benefits as the recipient of the Harkness Scholarship, suggesting but not mentioning those who awarded him the scholarship.

These specifications concern textual and experiential considerations in the use of the lexicogrammatical resources.

Textual considerations. At the point when (5) is generated, the text is organized according to the chronology of Farrell's life, information which leads to the selection of *in 1966* as Theme. The message thus starts out by orienting the reader temporally and this orienting temporal context has to be specified in the plan for the message. Nigel will then discover this specification and generate Time: *in 1966* as Theme of the clause. There is no conflict in the selection of *in 1966* as Theme with other textual considerations. If the year had been the news or the new point of the message, there would have been a good reason to put it towards the end of the clause, but it is not the news of the message. Assuming that the generator keeps track of what the news is, Farrell's achievement, the scholarship, is given that status and *a two-year Harkness Scholarship* appears as the last constituent. Consider the textual variants just in terms of the clause structure:

> (a) Farrell was awarded a two-year Harkness Scholarship in 1966.
>
> (b) A two-year Harkness Scholarship was awarded (to) him in 1966.

(c) They awarded him a two-year Harkness Scholarship in 1966.

(d) A two-year Harkness Scholarship he was awarded in 1966.

(e) It was Farrell who was awarded a two-year Harkness Scholarship in 1966.

The variant (a) presents Farrell rather than the year as Theme. It would be motivated if the plan for the organization of the text had specified Farrell to be introduced or re-introduced as 'topic'. In fact, the little biographic text starts out with this pattern: *J. G. Farrell was born in Liverpool in 1935.* In this first message, the news is Farrell's place and year of birth. Variant (b) does not present the scholarship as (unmarked) news, but makes it thematic rather than the year, which appears last. Thus, this variant gets the textual organization of the message wrong in two ways. Variant (e) would be appropriate if there were several candidates being discussed and Farrell had to be singled out, but it is not appropriate in this short biography where we are only concerned with Farrell.

Experiential considerations. The event in Farrell's life is represented as a benefactive material process, in which Farrell participates as Beneficiary (more specifically: Recipient) and the scholarship as Goal. There is an inherent Actor in a process of this kind, but the writer has chosen not to represent it, since the particular identity of the Agent is not important. Experiential variants include

(f) In 1966 he received a two-year Harkness Scholarship.

(g) From 1967 to 1968 he had a two-year Harkness Scholarship.

Variant (f) represents the event as a material action, but leaves out the indication of an Agent whose action benefits Farrell: Grammatically, Farrell is not the Beneficiary, and there is no inherent Agent as in *was awarded*. The version in the text represents the event from the perspective of the world honouring Farrell by acting to benefit him. Variant (g) is not a material action, but a relation; it represents the states of affairs resulting from the action of awarding, leaving the reader to infer the awarding action which honoured Farrell.

There is also a specification of the Time, *in 1966*, motivated by the fact that the text represents the biography of Farrell's life, something that proceeds through and is fixed in time.

The two metafunctional considerations are integrated and achieved simultaneously by the clause (cf. Fig. 4 and the notion of the grammar as integrator). The diagram in Fig. 19 below brings this out and summarizes my remarks.

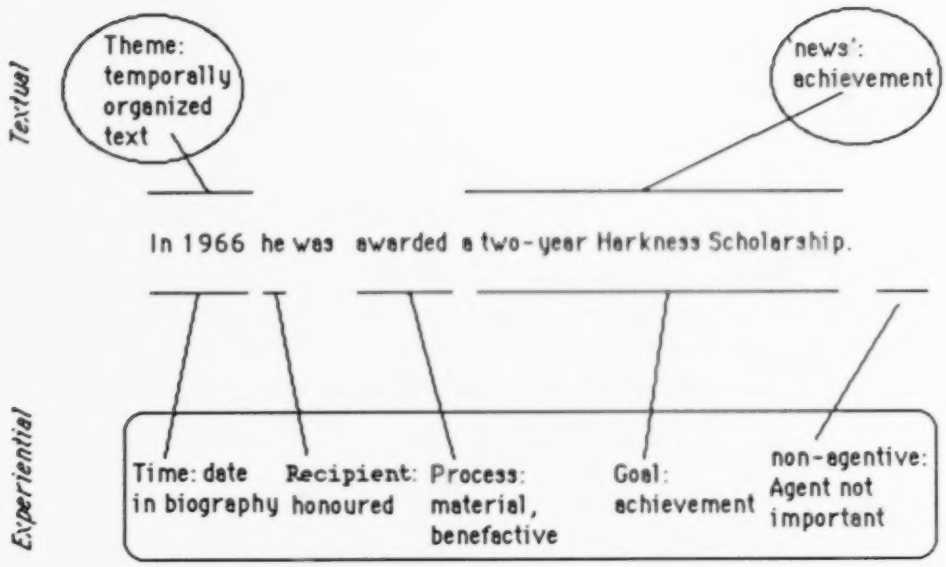

Fig. 20: One (integrated) wording, multiple functions

The diagram leaves out the interpersonal metafunction, since I have not discussed it in this paper. It is the metafunction we need to control variants such as *was he, he may have, he was ... wasn't he, he was not surprisingly,* etc..

ACKNOWLEDGEMENTS

I am greatly indebted to Michael Halliday. I have drawn heavily on his work and several ideas have been developed or clarified in discussions with him. I am also grateful to Bill Mann and Norm Sondheimer. They have lead the work on modelling within the Penman project, which has provided the context for this paper. I have benefitted from comments by Bill Mann, Lynn Poulton, and Susanna Cumming on earlier versions of the paper and from comments by participants in the third international language generation workshop. I am, of course, solely repsonsible for the use or misuse I have made of the various ideas and comments that have shaped the paper. The research reported on was supported by the Air Force Office of Scientific Research under contract no. FQ 8671-84-01007. Views and conclusions are the author's and should not be interpreted as representing the official opinion or policy of AFOSR or the U.S. Government.

FOOTNOTES

[1]*Lexicogrammar* is Halliday's term; see e.g. Halliday (1978). The term grammar is used in the traditional way, not in the recent more inclusive way it has been used in the transformational literature; it refers to syntax and morphology. Lexis is vocabulary. Lexicogrammar is the unified combination of the two; the resources of grammar and vocabulary.

[2]In what follows I shall treat lexicogrammatical expression as a unified process and lexicogrammar as a unified resource rather than as distributed process and distributed resources. In this respect, my treatment follows to a large extent the design of text-generation systems such as Davey's Proteus (Davey, 1978) and Penman (Mann, 1982). However, what I want to present is not really affected by the difference between a *unified* design and a *distributed* design. In fact, Halliday's functional decomposition of lexicogrammar (Halliday, 1967/8, etc.) suggests why distributed designs are sometimes used.

[3]The relationship can also be put in stratal terms. The Environment is stratally above Nigel.

[4]To be more precise, the distinctions obviously depend on a particular analysis of English, but different analyses could clearly be accomodated by the chooser and inquiry framework. For some discussion, see Matthiessen (in press).

[5]Halliday's metafunctional proposal can be compared with e.g. Dik's (1978). Halliday's ideational metafunction corresponds roughly to Dik's semantic component, his interpersonal partly to Dik's syntactic, and his textual to Dik's pragmatic. One difference is Halliday's differentiation of ideational into logical and experiential. Another difference is that Halliday proposes an interpersonal metafunction and interprets Subject as an interpersonal contribution to the structure of the clause, while Dik takes Subject to be a syntactic function.

[6]Adverbial groups may code qualities -- for example, the quality of the performance of a process; its speed, skill, etc. -- or circumstances -- for example times and places. The distinctions on both sides of the table are best thought of in terms of prototypes; see Hopper and Thompson (1984) for a discussion of nouns and verbs in terms of prototypes.

[7]The result is a metaphor where a sequence of two processes is represented as if it were a configuration and the two processes are represented as if they were things, see Halliday (1985: ch. 10) and cf. Hopper & Thompson (1984) on nominalizations.

[8]The conceptual inheritance hierarchy correlates with the system network in the grammar; moving downwards in the hierarchy corresponds to moving to the right in the system network.

[9]The distinction into four types comes from Halliday. It is intermediate in delicacy between three types

(cf. Halliday, 1968) and six types (cf. Halliday, 1985). Alternative taxonomies can be found in e.g. Chafe (1970), elaborated in Cook (1977), Longacre (1976), and Dik (1978).

[10]Halliday (1985) shows how these general categories of process, material, mental, verbal, and relational, are reflected in the grammar of transitivity in English and I will not repeat his discussion here. Briefly, the categories influence the number and nature of participants. For example, only verbal processes have an Addressee participant. A factive clause cannot participate in a material process, but does so quite naturally in a mental one. And so on. The use of marked tense combinations depends on the process type. Further, the possibilities of using a 'pro-verb' vary depending on the process type, and so does the unmarked tense selection.

REFERENCES

Allerton, D.J., E. Carney, and D. Holdcroft (eds.). 1979. *Function and Context in Linguistic Analysis. Essays Offered to William Haas.* Cambridge: Cambridge University Press.

Anderson, J. R. 1983. *The Architecture of Cognition.* Cambridge: Harvard University Press.

Bara, B.G. and G. Guida. (eds.). 1984. *Computational Models of Natural Language Processing.* Amsterdam: North-Holland.

Benson, J. & W. Greaves. 1985. *Systemic Perspectives on Discourse, Volume 1.* Norwood, NJ: Ablex.

Benson, J., M. Cummings, & W. Greaves. in press. *Systemic Perspectives on Discourse.* Amsterdam: Benjamins.

Brachman, R.J. 1978. *A Structural Paradigm for Representing Knowledge.* BBN Report No. 3605.

Brachman, R.J. & J. Schmolze. 1985. *An Overview of the KL-ONE Knowledge Representation System.* Cognitive Science, 9.2: 171-216.

Chafe, W. 1970. *Meaning and the Structure of Language.* Chicago: Chicago University Press.

Cook, W. 1977. *Case Grammar: Development of the Matrix Model (1970-1978).* Washington, D.C.: Georgetown University Press.

Danes, F. 1974. *Functional sentence perspective and the organization of the text.* In Danes (ed.).

Danes, F. (ed.) 1974. *Papers on Functional Sentence Perspective.* The Hague: Mouton.

Davey, A. 1978. *Discourse Production.* Edinburgh: Edinburgh University Press.

Derr, M.A. & McKeown, K.R. 1984. *Using Focus to Generate Complex and Simple Sentences.* In Proceedings of COLING 84.

Dik, S. 1978. *Functional Grammar.* Amsterdam: North-Holland.

Dik, S. to appear. *Generating Answers from a Linguistically Coded Knowledge Base.* In Kempen (to appear).

Fawcett, R.P. 1980. *Cognitive Linguistics and Social Interaction.* Heidelberg: Julius Groos Verlag.

Fawcett, R.P. and M.A.K. Halliday (eds.). to appear. *New Developments in Systemic Linguistics.* London: Frances Pinter.

Fox, B. to appear. *Discourse structure in written and conversational English.* Cambridge: Cambridge University Press.

Freedle, R.O. (ed.) 1977. *Discourse Production and Comprehension.* Norwood, N.J.: Ablex.

Fries, P.H. 1983. *On the Status of Theme in English: Arguments from Discourse.* Forum Linguisticum. Reprinted in Petofi & Sozer (eds.).

Givón, T. (ed.). 1983. *Topic Continuity in Discourse.* Amsterdam: Benjamins.

Haiman, J. and S.A. Thompson (eds.). in press. *Clause Combining in Discourse and Grammar.* Amsterdam: Benjamins.

Halliday, M.A.K. 1967. *Grammar, society, and the noun.* Inaugural lecture, reprinted in Halliday 1977.

Halliday, M.A.K. 1967/8. *Notes on Transitivity and Theme.* Journal of Linguistics. Vol. 3: 37-81; 199-244. Vol. 4: 179-215.

Halliday, M.A.K. 1973. *Explorations in the Functions of Language.* London: Edward Arnold.

Halliday, M.A.K. 1974. *Michael Halliday.* In Parret, *Discussing Language.* The Hague: Mouton.

Halliday, M.A.K. 1978. *Language as social semiotic.* London: Edward Arnold.

Halliday, M.A.K. 1979. *Modes of Meaning and Modes of Saying.* In Allerton, Carney, and Holdcroft (eds.).

Halliday, M.A.K. 1985. *An Introduction to Functional Grammar.* London: Edward Arnold.

Halliday, M.A.K. and R. Hasan. 1976. *Cohesion in English.* London: Longman.

Halliday, M.A.K. and R. Hasan. 1985. *Language, context, and text.* Victoria: Deakin University Press.

Hasan, R. to appear. *The Grammarian's Dream: Lexis as Most Delicate Grammar.* In Fawcett and Halliday (eds.).

Hinds, J. 1977. *Paragraph Structure and Pronominalization.* Papers in Linguistics 10, 77-99.

Hopper, P. and S. Thompson. 1984. *The Discourse Basis for Lexical Categories in Universal Grammar.* Language 60.703-52.

Hovy, E. 1986. *Putting Affect into Text.* Submitted to Eighth Conference of the Cognitive Science Society.

Hovy, E. & R. Schank. 1984. *Language Generation by Computer.* In Bara & Guida (eds.).

Jacobs, P. 1985. PHRED: *A Generator for Natural Language Interfaces.* Computational Linguistics, 11.4: 219-243.

Kempen, G. (ed.). to appear. *Natural Language Generation. Contributions from Computational Linguistics, Psycholinguistics, and Linguistics.*

Longacre, R.L. 1976. *An Anatomy of Speech Notions.* Peter de Ridder Press.

McKeown, K.R. 1982. *Generating Natural Language Text in Response to Questions about Database Structure*, Ph.D. Dissertation, University of Pennsylvania.

Mann, W.C. 1982. *The Anatomy of a Systemic Choice.* ISI/RR-82-104.

Mann, W.C. 1983a. *An Overview of the Penman Text Generation System.* ISI/RR-83-114.

Mann, W.C. 1983b. *An Overview of the Nigel Text Generation Grammar.* ISI/RR-83-113.

Mann, W.C. 1984. *Discourse Structures for Text Generation.* In Proceedings of COLING 84. Reprinted as ISI/RR-84-127.

Mann, W.C. & C. Matthiessen. 1985. *A demonstration of the Nigel text generation computer program.* In Benson & Greaves (eds.).

Mann, W.C. & S.A. Thompson. to appear, a. *Rhetorical Structure Theory: a Theory of Text organization and its Implications for Clause Combining.* In Polanyi (ed.).

Mann, W.C. & S.A. Thompson. to appear, b. *Rhetorical Structure Theory: Description and Construction of Text Structures.* In Kempen (ed.).

Martin, J.R. 1983. *Conjunction: the Logic of English Text.* In Petofi and Sozer (eds.).

Martin, J.R. 1986. *Transitivity in Tagalog: a functional interpretation of case.* Mimeo. Department of Linguistics, University of Sydney.

Matthiessen, C. 1981. *A Grammar and a Lexicon for a Text-Production System.* In The Proceedings of the 19th Annual Meeting of the ACL.

Matthiessen, C. 1983a. *Systemic Grammar in Computational Linguistics: The Nigel Case.* In The Proceedings of the 1st Meeting of the European chapter of the ACL.

Matthiessen, C. 1983b. *How to Make Grammatical Choices in Text Generation.* In The Tenth LACUS Forum. Columbia: Hornbeam Press.

Matthiessen, C. 1985. *The Systemic Framework in Text-generation: Nigel.* In Benson & Greaves (eds.).

Matthiessen, C. 1986. *The organization of the environment of a text-generation grammar.* MS, ISI/USC.

Matthiessen, C. in press. *A systemic semantics: The chooser and inquiry framework.* In Benson, Cummings & Greaves.

Matthiessen, C. and S.A. Thompson. in press. *The Structure of Discourse and Hypotaxis.* In Haiman and Thompson (eds.).

Moore, J. and Y. Arens. 1985. *A Hierarchy for Entities.* MS, ISI/USC.

Nebel, B. and N.K. Sondheimer. 1986. *A Logical-Form and Knowledge-Based Design for Natural Language Generation.* In Proceedings of AAAI-86, vol. 1.

Patten, T. 1986. *Interpreting Systemic Grammar as a Computational Representations: A Problem Solving Approach to Text Generation.* Ph.D. Dissertation, Edinburgh University.

Petofi, J. and E. Sozer. 1983. *Micro and Macro Connexity of Texts.* Hamburg: Helmut Buske Verlag.

Polanyi, L. (ed.). to appear. *Discourse Structure.* Norwood, N.J.: Ablex.

Rochester, & J.R. Martin, 1977. *The Art of Referring: The Speaker's Use of Noun Phrases to Instruct the Listener.* In Freedle (ed.).

Winograd, T. 1983. *Language as a cognitive process.* Syntax. Reading: Addison-Wesley.